Coverage and Impact of Adding vitamin A capsule (VAC) distribution to annual National Immunization Day in the Philippines

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Introduction

In the Philippines, evidence of significant clinical and subclinical VAD has been documented over the past two decades (Solon et al., 1978; Flores, et al. 1984; Klemm et al. 1992; Rosen et al. 1994; Valendria et al., 1994). The most recent national nutrition survey confirmed the prevalence of subclinical VAD among preschool-age children in 11 out of 15 regions, with the highest levels in poor rural provinces and urban poor areas (FNRI, 1993).

In 1993, at the International Conference on Nutrition (Rome, 1992), the Philippines pledged to virtually eliminate VAD and all of its consequences by the year 2000. Acting on this pledge the Philippines implemented a proactive universal supplementation strategy for quick-impact while developing longer-term interventions to address the underlying causes of VAD. The country was one of the first to incorporate vitamin A capsule (VAC) distribution among 1-4 year olds into its annual National Immunization Day (NID) conducted in April and design a special National Micronutrient Day (known locally as Araw ng Sangkap Pinoy or ASAP) approximately 6 months later (in October) to deliver a follow-up VAC to the same children (as well other micronutrients to women). These semi-annual campaigns targeted more than 9 million children. Existing health auxiliary or other, local volunteer staff were mobilized to administer the VAC at village health stations or other community-based locations promoted as "Patak" or "Sangkap" Centers nationwide.

Under controlled field trial conditions, high-dose vitamin A capsule (VAC) coverage rates have reached more than 80%, and corresponding significant declines in the prevalence of new cases of night blindness (XN) and Bitot's spots (X1B) as well as reduced mortality rates have been reported (Sommer A, et al, 1986; Katz et al., 1995; Beaton et al., 1993). Few studies, however, have evaluated the effectiveness of VAC supplementation and impact when programs are brought to national scale and implemented within the existing organizational and resource capacity of a national health service.

This paper presents data on VAC coverage and xerophthalmia prevalence collected before (1991) and after (1994) the Philippines implemented its universal vitamin A supplementation program. When the 1994 study was conducted, the Philippines had completed three rounds of semi-annual massive supplementation, two during NID's conducted in April 1993 and April

1994, and one during the October 1993 National Micronutrient Day. The paper examines changes in rates of VAC coverage and xerophthalmia prevalence before and after vitamin A supplementation was integrated into the national immunization days. It also compares the risk of xerophthalmia among children who received or did not receive a VAC during the 1994 NID distribution round.

Methods

This evaluation formed part of a USAID-supported collaborative technical assistance program between Helen Keller International (HKI) and Nutrition Service, Department of Health (NS/DOH) known as the VITEX project. This study was originally designed to permit a controlled evaluation of different delivery systems for providing vitamin A to children with specific risk conditions (such as underweight, chronic diarrhea and acute respiratory infections) and for providing weaning education to mothers of young children. In 1993, with changes in vitamin A supplementation policy (from a disease-targeted to a universal approach) and program strategies (from a passive clinic-based approach to the proactive distribution of VAC through annual National Immunization and Micronutrient Days), the portion of the study which aimed to evaluate alternative vitamin A delivery systems in a controlled way was dropped. Instead, the impact of universal supplementation on VAC coverage and xerophthalmia was evaluated using a quasi-experimental design.

From June to August, in 1991 and again in 1994, a cross-sectional survey was conducted in three Philippine provinces (Quezon, Northern Samar and Zamboanga del Sur). Data was collected from the same 118 randomly selected *barangays* (villages) during both surveys. The provinces were purposively selected as project sites based on comparatively high levels of child malnutrition, evidence of known or probably vitamin A deficiency, the absence of an active vitamin A supplementation program, and the DOH's list of under-served and high-priority child survival areas. Each province is located in one of the country's three major island groups (i.e. Luzon, Visayas and Mindanao). Quezon province, one of the largest provinces in the country, is on the island of Luzon about 2 hours (60 miles) south of Manila, has a population of 1.3 million people (1990 census), is largely rural and ethnically homogenous. Northern Samar, located in the Visayas, is one of the poorer provinces in the country, has a population of about 380,000 people (1990 census), and consists of interior low mountain ranges with most of the population inhabiting the coast. Zamboanga del Sur, located in Mindanao, with a population of 1.1 million (1990 census) is characterized by a long coast, lowlands, hilly lands, and thickly forested mountain ranges stretching the length of the entire province.

Sample Design.

A three-stage sampling design was used to select villages for inclusion in the surveys. The cities in each province were excluded from the sampling frame. The first stage in the sampling process involved sub-dividing all the health districts in each province into four relatively homogenous groups based on population size, and immunization coverage and the proportion of children participating in the annual child weighing program (known locally as Operation Timbang or OPT). This was done because the VITEX project planned to test the

effectiveness of alternative vitamin A and weaning education delivery systems. In the second stage, municipalities were again stratified according to low, medium and high levels of *OPT* coverage and two municipalities were systematically sampled from each OPT stratum based on probability proportionate to size. In the third stage, a list of villages with their respective population sizes was prepared for each sample municipality, and two villages (*barangays*) were systematically selected using a random start. Within each sample village the rural health midwife identified all mothers with children less than 7 years of age and requested them to come to the survey site with their children on the scheduled survey date. The average number of children surveyed per village was 124.2±46.3 and 130.7±48.7 in the baseline and endline surveys, respectively. No less than 80% of all children under 7 years of age in each village were included in the survey.

Sample Population.

The analyses presented in this paper are based on a subset of children from both surveys. Children who were between 12 and 59 months on April 15, 1994 (and thus eligible to receive a VAC during the 1994 NID) were included in the "post-intervention" (i.e. 1994) group. Children falling into the same age range in the 1991 survey were included as the "pre-intervention group".

In both surveys children were weighed and examined for signs of xerophthalmia. Weights were measured to the nearest 100 g by using 25 kg Saltier-hanging scales (CMS Weighing Equipment, London), with children wearing no more than a light pair of short trousers or a dress. Standing height (for children ≥24 mos) or recumbent length (for children <24 MOs) measurements were obtained during the 1994 survey only. Anthropometric measurements were converted to three indexes: height-for-age, weight-for-height, and weight-for-age. These indexes were then expressed as Z-scores relative to the international (NCHS/CDC/WHO) reference population to standardize the distribution. Children were classified as underweight, stunted or wasted if their respective Z-scores were less than 2 SDs below the age and gender-specific reference median.

Child characteristics such as age, sex, and participation in OPT were recorded. Socioeconomic indicators of household status such as education of mother, type of house, possession of radio or TV, and presence of electricity were also collected.

Children were examined for xerophthalmia by a survey team physician who was blinded to the VAC receipt status of the child. Night blindness was diagnosed by questioning those responsible for the child. Night blindness has been shown to be sensitive and highly specific for predicting deficient levels of serum vitamin A in Indonesia (Sommer et al, 1980) and Bangladesh (Stoll et al, 1985). Data from Mindanao also suggests the same holds true in the Philippines (Rosen et. al. 1994). A history of night blindness was elicited from the mother by asking if her child experienced difficulty seeing at night. If the mother offered the local term for night blindness for the child's condition, the child was considered night blind. Words for night blindness exist in the local dialects in each study province. Night blindness prevalence was computed for children ≥24 mos to minimize misclassification bias. Each eye was examined by a team physician with the use of a flashlight. Bitot's spots and corneal ulcers were recorded when observed. Only corneal scars which were non-trauma related and observed shortly after an illness

episode of the child were considered xerophthalmia-related. All children confirmed to have active xerophthalmia or its sequelae (corneal scars) were given three large doses of vitamin A over a two-week period.

To assess vitamin A capsule (VAC) coverage, the parent or guardian of each child was shown a high-dose vitamin A capsule and asked if the child had ever been given one. A follow-up question was asked to establish the time or occasion when the VAC was administered. Baseline and endline coverage was defined as having received at least one high potency vitamin A capsule within 6 months of the survey date.

Data Collection

Two field teams per province, each consisting of an anthropometrist, two interviewers, a medical doctor and a field supervisor, were employed by the project. Each worker was from the respective study province and fluent in the local language. Team training was conducted jointly by the DOH and HKI investigators during the month preceding start-up of each survey . Each anthropometrist was observed for appropriate measuring technique and conducted measurements until each step in the manual of operations was correctly followed. Medical doctors were trained in xerophthalmia assessment by an ophthalmologist from the Institute of Ophthalmology, University of the Philippines. Each team underwent a field practicum to practice interviewing, weighing, xerophthalmia assessment and recording skills. Field supervisors from HKI and the DOH accompanied each team during the survey to assess problems and supervise data collection. Periodic random checks were made on the data to ensure consistency and accuracy.

Statistical analyses

The resulting data were single-entered into computers in Manila. Analyses were carried out by using dBase III+ (Borland International Inc., Scotts Valley, CA) and Intercooled Stata 5.0 for Windows (Stata Corp., TX). Two-tailed significance tests were used throughout.

Comparisons between mean values were made by Student's t-test and ANOVA, while analysis which compared differences between proportions were assessed by χ^2 test statistics. Multivariate analyses were undertaken by using logistic regression methods to test models which could best predict vitamin A capsule receipt, night blindness and Bitot's spots among children. Logistic regression coefficients are presented as antilogarithms (thus, as odds ratios).

The cluster sample design used to select the children for the study violated standard independent assumptions in sample selection. To the extent that children within the same cluster (i.e. village) have characteristics that are more like one another than children selected from other clusters in the study, the actual variance of estimates may be considerably larger than that computed using simple random sampling principles. Variance estimates and test statistics presented in these analyses have been computed for the effects of the design on estimation and inference using survey estimation commands provided in STATA Release 5.0 treating barangays as the principle sampling unit.

Results

Characteristics of the sample

Table 1 compares the characteristics of the surveyed populations before (1991) and after (1994) the DOH's universal VAC distribution campaign. Children surveyed in 1994 were, on average, a half-month older, had markedly better weight-for-age status, had slightly older mothers and mothers with slightly higher levels of education. There was no evidence of differences in gender distribution of children, usual occupation of mothers or household socio-economic status (as measured by type of house) between the two populations.

Table 1. Selected characteristics of children (12-64 months of age), their mothers and households surveyed from the same villages before (in 1991) and after (in 1994) the DOH's universal vitamin A capsule distribution campaign.

Characteristics	**Before**	**After**
Child Characteristics	n=7717	n=7606
Mean age of children, mos (x±ds)**	36.9±14.5	37.5±13.9
Age Group (%) ***		
1 2-23 months	25.1	22.3
24-35 months	24.5	25.8
36-47 months	23.2	24.2
48-59 months	21.1	22.6
60-64 months	6.0	5.2
Gender (%)		
Females	49.3	48.8
Males	50.7	51.2
Mean weight-for-age Z-score (x±sd) ***	-1.96±0.91	-1.78 ±0.90
Underweight***		
Weight-for-Age Z score< -2 (%)	48.8	40.6
Weight-for-Age Z score≥-2 (%)	51.1	59.1
Maternal Characteristics	n=5516	n=5597
Age of mother, yrs (x±sd) *	31.1±8.4	31.5±8.8*
Educational attainment of mother (%) ***		
elementary or less	57.4	51.6
any high school	32.9	35.9
post high school	9.75	13.1
Mothers Usual Occupation		
Housewife	86.2	86.2
Works Outside House	13.8	13.8
Household Characteristics		
Type of house (%)		
nipa hut	50.9	51.2
wood/cement	49.1	48.8
Household Electricity		
Absent	71.2	65.6
Present	28.8	34.4

* p<0.05; ** p<0.01; ***p<0.001

VAC Coverage

Table 2 compares vitamin A capsule coverage rates before (1991) and after (1994) the DOH integrated universal VAC distribution into its NID campaign. In 1991, less than 6% of mothers reported that their children 12-59 months of age had received a VAC during the six months prior to the survey. In 1994 this proportion dramatically increased to an average of 80%.

Table 2. VAC coverage among children 12-59 months of age by selected child, mother and household characteristics: before (in 1991) and after (in 1994) the DOH's massive vitamin A capsule distribution campaign

Variable	VAC † Coverage Before n=6832	VAC † Coverage After n=7322
Overall ***	5.7	80.4
Province		
Quezon ***		81.7
N. Samar ***		85.9
Zamboanga del Sur ***		75.4
Age Group		
12-23 mos ***	6.2	78.8
24-35 mos***	5.5	81.7
36-47 mos***	5.8	81.9
48-59 mos***	5.8	79.0
60-71 mos***	3.8	80.2
Gender		
Females***	6.2	80.8
Males***	5.2	80.1
Underweight		
Weight-for-Age Z score< -2(%)***	7.0	79.3
Weight-for-Age Z score≥-2 (%)***	4.5	81.2

*** p<0.0001
† VAC, vitamin A capsule

In comparing characteristics of children who received or did not receive a VAC during the six months previous to the 1994 survey, children who were stunted or underweight were slightly more likely to receive a VAC than non-stunted and non-underweight children (Table 3). Children who had better educated mothers, or lived in houses made from more study materials (cement and/or wood) were also slightly more likely to receive a VAC than children whose mothers had only an elementary school education, or children who lived in houses made from bamboo and thatched palm leaves (not shown). There were also large and statistically significant differences in VAC coverage across the three study provinces (not shown). There were no significant differences in VAC receipt by age or gender of child at $p<0.05$.

Table 3. Characteristics of recipients and non-recipients of vitamin A capsules during the previous 6 months among children aged 12-59 months at the time of the National Immunization Day, April 1994, in 3 VITEX provinces (n=7322)

Variable	VAC† recipients			Non-recipients		
	No.	Mean	SD†	No.	Mean	SD†
Age (months)	5889	37.5	13.7	1433	37.4	14.4
Stunting (height-for-age Z score)	5830	-2.01	1.21	1419	-2.12*	1.26
Underweight (weight-for-age Z score)	5829	-1.77	0.89	1431	-1.84*	0.92
Wasting (weight-for-height Z score)	5829	-0.74	0.82	1424	-0.75	0.75

* p<0.01
† VAC, vitamin A capsule; SD, standard deviation

Table 4 shows, through logistic regression analysis, that children of better educated mothers (odds ratio (OR) = 1.33, 95% CI: 1.15-1.56), of mothers who possessed specific knowledge about vitamin A (OR=2.08, 95% CI 1.78-2.43), of better-off households as measured by type of materials used to construct the house (OR=1.22, 95% CI 1.05-1.42) and children from Northern Samar province (OR=1.27, 95 percent CI 1.04-1.54) had a higher odds of receiving a capsule than children from the corresponding reference group. Anthropometric status did not remain in the model.

Table 4. Logistic regression analyses of the odds of receiving a vitamin A capsule (VAC) among children 12-59 months during the 1994 NID (n=6573)†

Variable	OR‡	95%CI‡	p-value
Mothers Formal Education (>elementary)	1.33	1.15-1.56	0.000
Can name at least one vitamin A food source¶	2.08	1.78-2.43	0.000
House made of wood &/or cement‰	1.22	1.05-1.42	0.008
Northern Samarc	1.27	1.04-1.54	0.000
Zamboanga del Surc	0.58	0.49-0.69	0.000

† Age group, gender, stunting, wasting and underweight status of child were variables that did not remain in the equation
‡ OR, odds ratio; CI, confidence interval
¶ Reference category, cannot name at least one food source of vitamin A
‰ Reference category, house made of palm leaves and bamboo
¢ Reference category, Quezon province

Xerophthalmia

Prevalence of all clinically evident ocular disease significantly decreased between 1991 and 1994 in all three provinces, except for Bitot's spots prevalence in Zamboanga del Sur (Table 5). Night blindness (XN) and Bitot's spots (X1B) prevalence decreased by 72% and 55%, respectively. However, there was a 2-fold increase in the Bitot's spots prevalence in Zamboanga del Sur. During the 1994 survey, only one child was detected with an active corneal lesion (X2/X3) compared with 5 in 1991 (p=0.11), and only 7 were diagnosed with a non-trauma related corneal scar compared with 24 in 1991 (p=0.003).

Table 6 presents the prevalence of night blindness (XN), Bitot's spots (X1B) and corneal scars (XS) before and after the massive VAC distribution campaign by selected child, mother and household characteristics. Comparisons for active corneal lesions are not included due to the small number observed. Before the universal VAC campaign, night blindness, Bitot's spots and corneal scar prevalence rates all exceeded WHO cut-off points for all provinces (except Bitot's spots for Quezon) and all age groups (except for Bitot's spots rates among 1 year olds). After the intervention each sign of xerophthalmia dropped across every province (except Bitot's spots in Zamboanga del Sur) and age group (except Bitot's spots among 5 year olds).

Table 5. **Prevalence rates and 95% confidence intervals (CI) of most severe sign of xerophthalmia (XN=Night blindness, X1B=Bitot's spots, X2/X3=Active Corneal Lesions, XS=Corneal Scars) for children 12-59 months old, total and by province: before (1991) and after (1994) the universal vitamin A distribution campaign**

			Province-Specific					
	Total		Quezon		Northern Samar		Zamboanga del Sur	
Xerophthalmia Sign	Before n=7717	After n=7607	Before n=2346	After n=2397	Before n=2181	After n=2274	Before n=3190	After n=2936
XN [1] per 100	2.32	0.63	2.20	0.27	6.00	1.02	1.80	0.62
95% CI	2.71-3.63	0.44-0.82	1.56-3.00	0.09-0.63	4.9-7.27	0.60-1.60	1.34-2.47	0.34-1.03
X1B per 100	1.09	0.49	0.48	0.0	2.68	0.18	0.54	1.09
95% CI	0.87-1.35	0.34-0.67	0.24-0.85	0-0.15	2.04-3.48	0.05-0.45	0.32-0.86	0.75-1.54
X2/X3 per 10,000	6.7	1.3	4.3	0.0	4.9	0.0	9.6	3.5
95% CI	2.1-15.6	0.3- 7.4	0.1-24.3	0-15.4	0.1-27.4	0-16.4	2.0-28.0	0.9-19.2
XS per 10,000	31.1	9.2	25.6	8.3	68.8	17.6	9.4	3.4
95% CI	19.9-46.2	3.7-19.0	9.4-55.6	1.0-30.1	38.6, 113.2	4/8-45.0	1.9-27.5	0.9-19.0

[1] computed for children >-= 24 months

Night blindness and Bitot's spots rates were significantly lower for boys ($p<0.001$) after the vitamin A campaign , whereas only night blindness rates were significantly reduced for girls ($p<0.001$). All other sub-groups (except for children of mothers with more than a high school education) registered significant before-after declines in night blindness. Bitot's spots rates were significantly reduced across normal and low weight-for-age groups ($p=0.002$ and $p=0.004$, respectively), children of the least educated mothers ($p<0.001$), children with mothers who had either no or specific vitamin A knowledge, and children of worse-off and better-off households as determined by type of house ($p<0.001$ and $p=0.04$, respectively) after the massive vitamin A campaign compared with levels prior to the campaign. Non-corneal involvement was also less prevalent across all groups after the massive vitamin A intervention. No corneal scarring was found among children 12-35 months of age. There were statistically significant before-after differences in rates for corneal scarring among children from Northern Samar ($p=0.009$), children 36-47 months of age, girls ($p=0.001$), underweight ($p=0.05$) and normal weight ($p=0.03$) children, children of mothers with an elementary education or less, children whose mothers had specific knowledge about vitamin A.

Effects of vitamin A dosing

The prevalence estimates and associated relative risks and 95 percent confidence limits of night blindness and Bitot's spots for children who and did not receive a high-dose vitamin A capsule during the 1994 NID are presented in Table 7. Among non-VAC-recipients ≥24 months, the night blindness rate was 1.38 (95% CI 0.78-2.26) in 1994. This is 65% lower than the night blindness rate among the same age group of children in 1991 suggesting that background rate of night blindness was lower in 1994 compared with 1991. Despite this lower rate the risk of night blindness among VAC recipients was lower than the risk among non-recipients across all age groups, gender, anthropometric classifications (except weight-for-age Z scores<-2), maternal educational levels, knowledge levels of vitamin A foods, and type of house. The night blindness risk was significantly lower among VAC-recipient children who were 48-59 months of age (RR=0.26, 95% CI: 0.09-0.75), males (RR=0.39, 95% CI: 0.17-0.90), stunted children (RR=0.42,

95% CI: 0.20-0.89), normal weight-for-age children (RR=0.28, 95% CI: 0.11-0.71), non-wasted children (RR=0.37, 95% CI:0.20-0.72), children whose mothers had completed any high school (RR=0.27, 95% CI: 0.0.10-0.70), children whose mothers knew at least one vitamin A food source (RR=0.13, 95% CI: 0.13-0.74) and children from homes made of nipa and bamboo (RR=0.29, 95% CI: 0.12-0.68) compared to their non-recipient counterparts.

Table 6. Night blindness (XN), Bitot's spots (X1b) and Corneal Scar (XS) prevalence for children between 12-59 months of age by selected child, household and mother characteristics: before(1991) and after (1994) universal vitamin A distribution campaign

	Night blindness (XN)†		Bitot's Spots (X1B) per 100		Corneal Scar (XS) ‡ per 10, 000	
Characteristics	Before n=5777	After n=5915	Before n=7717	After n=7606	Before n=7717	After n=7717
Child Characteristics						
Overall	3.96	0.71***	1.09	0.49***	31.1	9.2**
Province						
Quezon	2.65 [n=1739]	0.27 [n=1839]***	0.47 [n=2346]	0.00 [n=2397] **	25.6	8.3
Northern Samar	8.25 [n=1684]	1.18 [n=1774] ***	2.57 [n=2181]	0.18 [n=2274] ***	68.8	17.6 **
Zamboanga del Sur	1.87 [n=2354]	0.70 [n=2302] ***	0.53 [n=3190]	1.12 [n=2936] *	9.4	3.4
Age group						
12-23 months	-	-	0.31 [n=1940]	0.12 [n=1692]	10.3	0.0
24-35 months	2.17 [n=1892]	0.66 [n=1963] ***	0.90 [n=1892]	0.15 [n=1963] **	15.9	0.0
36-47 months	4.02 [n=1789]	0.49 [n=1843] ***	1.01 [n=1789]	0.71 [n=1843]	39.1	5.4 *
48-59 months	5.33 [n=1632]	0.87 [n=1716] ***	2.21 [n=1789]	0.64 [n=1716] ***	30.6	11.7
60-64 months	6.25 [n=464]	1.28 [n=392] ***	1.51 [n=464]	2.04 [n=392]	150.9	102.0
Gender						
Females	2.98 [n=2853]	0.59 [n=2888] ***	0.60 [n=3805]	0.40 [n=3715]	28.9	0 **
Males	4.92 [n=2924]	0.83 [n=3027] ***	1.56 [n=3912]	0.57 [n=3892] ***	33.2	18.0
Underweight						
Weight-for -age Z Score <-2	4.44 [n=2724]	1.04 [n=2303] ***	1.12 [n=3766]	0.49 [n=3065] **	37.2	13.0*
Weight-for -age Z Score ≥-2	3.55 [n=3043]	0.50 [n=3567] ***	1.07 [n=3940]	0.49 [n=4499] **	25.4	6.7*
Mothers Characteristics						
Educational attainment of mother	5.25 [n=3011]	0.72 [n=2784] ***	1.68 [n=3997]	0.53 [n=3568] ***	40.0	8.4 **
elementary or less	2.75 [n=1671]	0.89 [n=1909] ***	0.53 [n=2258]	0.41 [n=2453]	26.6	12.2
any high school	0.77 [n=518]	0.14 [n=699]	0.29 [n=683]	0.44 [n=901]	29.3	0
post high school	3.64 [n=577]	0.76 [n=523] **	0.30 [n=779]	0.58 [n=685]	0	14.6
missing						
Knowledge of Vitamin A Food Source						
Does Not Know	4.39 [n=3009]	1.16 [n=1379] ***	1.25 [n=4012]	0.44 [n=1799] **	37.4	22.2
Knows at least one	3.43 [n=2185]	0.54 [n=3878] ***	1.06 [n=2919]	0.46 [n=4955] **	30.8	4.0 **
Household Characteristics						
Type of house						
nipa hut	5.17 [n=2670]	0.75 [n=2806] ***	1.55 [n=3541]	0.55 [n=3611] ***	39.5	13.8 *
wood/cement	2.77 [n=2525]	0.66 [n=2586] ***	0.77 [n=3390]	0.39 [n=3311] *	29.5	3.0**
missing	3.61 [n=581]	0.75 [n=523] **	0.38 [n=786]	0.58 [n=685]	0	14.6
Village Characteristics						
VAC Coverage Level in 1994						
<75%	3.90 [n=1641]	0.96 [n=1565] ***	1.04 [n=2207]	0.84 [n=2013]	22.7	9.9
75%-89%	3.51 [n=2425]	0.87 [n=2516]***	1.04 [n=3274]	0.55 [n=3247]*	39.7	9.2*
≥90%	4.68 [n=1711]	0.27 [n=1833]***	1.21. [n=2236]	0.09 [n=2346]***	26.8	8.5

p<0.01, ** p=0.001, *** p<0.001
† night blindness prevalence computed for children ≥24 months of age
‡ Strataspecific number of subjects is the same as those for Bitot's spots

Among non-recipient children, the Bitot's spots rate was 1.12 (95% CI: 0.57-1.66), which is comparable to the 1991 baseline rate of 1.09 (95% CI: 0.86-1.32) rate of children in 1991. The risk of Bitot's spots among children who received a VAC in the previous 6 months were lower across all ages, genders, anthropometric classifications, maternal educational levels, maternal knowledge of vitamin A foods, and type of house relative to non-recipient children. Significant risk differences were found among VAC-recipient children who were older (60-63 months of age), male, non-stunted, normal weight, non-wasted, had mothers who completed up to elementary school or any high school, and lived in either nipa or cement and wood houses compared with their non-recipient counterparts.

Table 8 shows the results of logistic regression analyses testing for the odds of having night blindness for children surveyed in 1994. Mothers of children who received a VAC during the previous 6 months were less than half (0.41, 95% CI: 0.21-0.76) as likely to report night blindness among their children compared with mothers whose children did not receive a VAC, controlling for stunting status, maternal knowledge about vitamin A foods and household electricity. Night blindness was not associated with age or sex of child, weight-for-age or wasting status of child, educational attainment or employment status of mother, or household economic status (as indicated by type of house).

Table 9 shows the model which tests the odds associated with Bitot's spots among children surveyed in 1994. Only VAC receipt during the previous 6 months and younger were negatively associated with the odds of being diagnosed with Bitot's spots. Children who had received a VAC during NID were 0.42 (95% CI: 0.22-0.86) times less likely to be diagnosed with Bitot's spots controlling for age. As with night blindness, there was no association with sex of child, weight-for-age or wasting status of child, educational attainment or employment status of mother, or economic status (as indicated by type of house); nor was there any association with stunting status or specific maternal knowledge about vitamin A.

To determine if the differences in before and after xerophthalmia prevalence rates varied with adequacy of VAC coverage, we retrospectively grouped villages into three levels of VAC coverage achieved in 1994, namely <75%, 75-89% and ≥90%. We computed the percent change in before-after night blindness and Bitot's spots prevalence rates by these coverage categories. Night blindness and Bitot's spots rates appeared to decrease as village coverage rates increased.

Table 7. **Strata-specific odds and 95% confidence interval (95%CI) of night blindness and Bitot's spots among children 12-59 months of age who did NOT receive a vitamin A capsule (VAC) during NID compared with the odds among children who DID receive a VAC during the 1994 NID.**

	Prevalence (%) of night blindness †				Prevalence (%) of Bitot's spots			
Variable	Non-Recipients	VAC ‡ recipients	RR‡	95%CI ‡	Non-Recipients	VAC ‡ recipients	RR‡	95%CI‡
Child Characteristics								
Overall	1.38	0.56	0.41	0.21-0.77**	1.12	0.36	0.32	0.16-0.61***
Age group								
12-23 months			-	-	0.00	0.22	-	.
24-35 months	1.44	0.52	0.35	0.12-1.09	0.36	0.08	0.23	0.01-3.67
36-47 months	0.62	0.48	0.77	0.16-3.73	1.91	0.74	0.38	0.12-1.18
48-59 months	2.04	0.54	0.26	0.09-0.75**	1.69	0.67	0.39	0.11-1.41
60-63 months	1.32	1.30	0.99	0.11-8.98	8.33	1.01	0.11	0.02-0.63**
Gender								
Females	1.13	0.49	0.43	0.16-1.17	0.99	0.43	0.43	0.14-1.30
Males	1.62	0.64*	0.39	0.17-0.90*	1.56	0.45	0.29	0.12-0.71**
Stunting								
Height-for-age Z score <-2 52.4%)	1.88	0.79	0.42	0.20-0.89*	1.21	0.57	0.46	0.18-1.19
Height-for-age Z score ≥-2	0.81	0.35	0.43	0.13-1.42	1.42	0.33	0.23	0.08-0.65**
Underweight								
Weight-for-age Z score <-2 (40.7%)	1.56	0.90	0.57	0.23-1.41	0.88	0.47	0.53	0.16-1.78
Weight-for-age Z score ≥-2	1.25	0.35	0.28	0.11-0.71**	1.60	0.43	0.26	0.11-0.62**
Wasting								
Weight-for-Height Z score <-2	0.00	1.07	-	0	0.00	0.43	-	
(5.5%)	1.45	0.55	0.37	0.20-0.72**	1.38	0.45	0.32	0.16-0.65**
Weight-for-Height Z score ≥-2								
Mothers Characteristics								
Educational attainment of mother								
elementary or less	1.33	0.56	0.42	0.17-1.02*	1.17	0.36	0.31	0.12-0.76*
any high school	2.33	0.63	0.27	0.10-0.70**	1.22	0.25	0.20	0.06-0.70**
post high school	0.00	0.17	-	-	0.72	0.40	0.55	0.06-5.31
Knowledge of Vitamin A Food Source								
Does Not Know	1.93	0.91	0.47	0.17-1.26	1.47	0.08	0.05	0.01-0.42***
Knows at least one	1.30	0.40	0.31	0.13-0.74**	0.86	0.39	0.45	0.18-1.10
Household Characteristics								
Type of house								
nipa hut	1.72	0.50	0.29	0.12-0.68**	1.32	0.36	0.27	0.11-0.64**
wood/cement	1.19	0.56	0.47	0.16-1.34	0.89	0.29	0.33	0.11-1.00*

* p<0.01, ** p=0.001, *** p<0.001
‡ VAC, Vitamin A capsules; RR, Relative Risk ; CI, confidence interval
†among 24-59 month old children at the time of the 1994 NID

Table 8. Logistic regression analyses of the odds of having night blindness (among 24-59 months old children) after the massive vitamin A capsule distribution campaign, 1994 (n=5146).†

Variable	OR‡	95% CI‡	p
VAC received during previous 6 months*	0.40	0.20-0.78	0.007
Stunted**	2.11	1.04-4.30	0.039
House has electricity***	0.36	0.14-0.94	0.037
Can name at least one vitamin A food source****	0.53	0.27-1.02	0.059

† Age group of child, gender of child, maternal educational level, type of house, and VAC coverage level of village were variables that did not remain in the equation.
‡ OR, odds ratio; CI, confidence interval
* Reference category, non-VAC recipients
** Reference category, non-stunted children
*** Reference category, households with no electricity
***** Reference category, Mother cannot name a food containing vitamin A

Table 9. Logistic regression analyses of the odds of having Bitot's spots (among 12-59 months old children) after the massive vitamin A capsule distribution campaign, 1994 (n=7322). †

Variable	Odds Ratio‡	95% CI‡	p
VAC received during previous 6 months*	0.42	0.22-0.86	0.017
Age group**			
3 years	5.35	1.90-15.04	0.001
4 years	4.64	1.61-48.14	0.005
5 years	15.61	5.06-48.14	0.000
VAC coverage level of village			
75%-89%	0.81	0.41-1.63	0.56
≥90%	0.14	0.03-0.61	0.03

† Age group of child, gender of child, maternal educational level, type of house, and stunting were variables that did not remain in the equation.
‡ OR, odds ratio; CI, confidence interval
* Reference category, non-VAC recipients
** Reference category, children 12-23 years of age
*** Reference category, village VAC coverage <75%

Table 10. Night blindness (XN) and Bitot's spots (X1B) prevalence before (in 1991) and after (in 1994) the DOH's universal VAC supplementation campaign stratified by village coverage levels of VAC in 1994.

	XN (%) Prevalence			X1B (%) Prevalence		
Village VAC Coverage levels in 1994	Before	After	Prophylactic Efficacy (%)	Before	After	Prophylactic Efficacy (%)
<75%	3.99 [n=1580]	0.96 [n=1565]	76	1.08 [n=2127]	0.84 [n=2013]	22
75%-89%	3.46[n=2486]	0.87 [n=2516]	77	1.01 [n=3354]	0.55 [n=3247]	46
≥90%	4.68 [n=1711]	0.27 [n=1833]	94	1.21 [n=2236]	0.09 [n=2346]	93

Discussion

Critical to any VAC distribution program is coverage of the target group. Gillespie and Mason conclude that adequate population coverage is difficult to attain with universal supplementation programs (Gillespie and Mason, 1994). West and Sommer estimate that universal vitamin A distribution systems need to achieve ≥65% coverage for favorable impact on mild xerophthalmia (West and Sommer, 1984). Based on the community field trials, only a coverage rate of 80% or better can be expected to yield young child mortality reductions in the order of 23%, on average, in vitamin A deficient populations.

Within a year and a half of program implementation, the Philippine program achieved ~80%coverage of all 12-59 month old children in the three study provinces as a direct result of integrating VAC distribution with the National Immunization Day conducted on April 15, 1994. Over 60% of the 118 survey villages achieved a coverage rate of ≥80%. Previous coverage estimates from the same provinces in 1991, obtained during the period when the DOH started implementing a disease-targeted approach for VAC supplementation, were ~6%.

Several studies have shown that the children who are not reached by universal supplementation programs are likely to be at greater xerophthalmic risk than those reached (Bloem et al., 1995; Cohen et al., 1985). Our findings are similar, even with the high coverage level achieved. Children from poorer socio-economic status (and presumably at greater risk for

VAD) are about 20% less likely to receive VAC than children from better-off families (as measured by maternal education, type of house and mothers' vitamin A-specific knowledge).

The large variation in coverage levels across the three study provinces suggests that there are province-specific factors which exert an independent effect on VAC coverage. These factors might include conditions which are not easily changed such as rugged geography and poor accessibility to service points. However, they may also include factors which are more readily changeable such as timing and adequacy of VAC supply at local delivery points. Depletion or shortage of capsules or concentration at distribution points is consistently the most widely quoted reason for impaired program performance at the local level (West and Sommer, 1984).

Is there evidence of a causal link between the high VAC coverage level (~80%) achieved and the large differences in xerophthalmia prevalence rates observed between the surveys conducted before (in 1991) and after (in 1994) the DOH's universal VAC supplementation program? Program impact depends on both efficacy and program performance. The before-after intervention findings on XN and X1B rates indicate a percent change of ~79% and ~57%, respectively. By achieving an average coverage rate of 80%, the program was able to significantly reduce XN to substantially less than 1.0%, X1B rates to less than 0.50%, and XS to less than 10 per 10,000 over the three year period. These percent reductions are consistent with those found in studies. The magnitude and consistency of the direction of changes in prevalence across the three study provinces suggest a strong program effect. The case for program impact is strengthened by the apparent dose-response relationship observed between xerophthalmia and VAC coverage rates. Night blindness and Bitot's spots rates appeared to vary inversely with higher VAC coverage, even though overall VAC coverage was high (Table 10).

No non-trauma-related corneal scars were observed among children less than 36 months of age during the 1994 survey compared with 5 observed in the same age group three years earlier. This suggests that the government's VAC program may have prevented active corneal disease through the cumulative effect of its disease-targeted VAC distribution program (implemented from December 1991 to March 1993) and its universal VAC distribution program (implemented from April 1993 to April 1994). Given the permanent burden that visual impairment and blindness place on a family and community, this finding is particularly noteworthy.

Clearly, before-after analyses of the type analyzed here, despite being based on standardized methods, are limited as compared with controlled trials. In the absence of a concurrent control population, the direct effect of the vitamin A program cannot be definitively estimated. The long interval (3 years) overwhich the reduction in prevalence of xerophthalmia took place makes a causal inference about the dramatic xerophthalmia reductions and VAC supplementation less clear. Potential confounding factors such as seasonal, cultural and environmental factors can change dietary and disease patterns over time, and consequently, the incidence or duration of xerophthalmia in the community.

To some extent, seasonal and cultural influences were controlled for because the surveys were conducted during identical months and in the same villages. However, the large differences in nutritional status between the two populations suggests that other factors may have contributed to the observed xerophthalmia reduction. There was a 10% increase in weight-for-age

Z-scores between 1991 and 1994, and a 17% decrease in the proportion of children who were underweight. Also, given the study design, the cohort effect could not be measured.

Despite these limitations, an important advantage of the study is the opportunity to evaluate impact under actual programmatic conditions. When restricting the analyses to children surveyed in 1994, there was still strong evidence for the protective role of VAC against xerophthalmia, despite their better weight-for-age status. Children who had received a VAC in the previous 6 months were less than half as likely to have a history of night blindness (RR=0.41, 95% CI: 0.21-0.77), and less than one-third as likely to be diagnosed with Bitot's spots (RR=0.32, 95% CI:0.16-0.61) compared with non-recipient children. After adjustment for potential confounders, the relative risks changed only slightly. Viewed together, the findings from the before/after and the recipient/non-recipient analyses make a strong case for a causal association between the high VAC supplementation coverage achieved and the corresponding large reductions in xerophthalmia observed.

Measuring vitamin A impact on young child mortality was beyond the scope of this study. However, given the similarity between the VAC coverage rates and population setting (poverty, evidence of general deprivation marked by stunting, evidence of the existence of xerophthalmia, and high mortality rates) of the DOH program and those of the vitamin A and mortality trials, it is reasonable to assume a mortality impact.

In 1996, the Government of the Philippines committed to extend its universal supplementation program an additional three years until 1998. This decision was prompted by a combination of factors, some of which include the continuation of Knock-out Polio days (similar to NID) which provide a venue for VAC distribution, the popularity of the National Micronutrient Day, and the absence of evidence that food-based and/or fortification efforts are ensuring adequate vitamin A intake of target children in high-risk areas.

This decision raises two important considerations. One relates to sustaining the DOH's high coverage levels, and the other to a policy question about how and on what criteria to phase out community-based supplementation. On the first issue, evidence from the annual cluster surveys conducted by the DOH after the National Micronutrient Days show signs of gradually declining coverage from 1993 to 1996, although coverage rates have not dropped below 80%, on average, in any year (Dayrit et al., 1994; DOH, 1995; Serdoncillo M, 1996). This is somewhat worrisome because the Philippines, more than many developing countries, has decentralized responsibility and authority for health services to its 1600 townships (municipalities). This complicates the distribution of centrally procured VAC as it relies on the commitment and competence of local health authorities to achieve high coverage. On the second issue, currently there is no surveillance system in place which provides policy makers with timely information on whether alternative interventions (such as food-based strategies or fortification) ensure adequate and more sustainable improvement in the vitamin A status of target children in high-risk areas. These are areas which warrant further investigation.

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References

Beaton GH, Martarell R, L'Abbe KA, Edmonston B, McGabe G, Ross AC, Harvey B. Effectiveness of vitamin A supplementation in the control of young child morbidity and mortality in developing countries. ACC/SCN State of the Art Series: Nutrition Policy Discussion Paper No 13. Geneva, Switzerland: Administrative Committee on Coordination-Sub Committee on Nutrition (ACC/SCN) 1993.

Bloem MW, Hye A, Wijnroks M, Ralte A, West KPJ, Sommer A. The role of universal distribution of vitamin A capsules in combating vitamin A deficiency in Bangladesh. Am J Epidemiol 1995; 142:843-55.

Dayrit MM, White ME, Magboo FP, Flores-Cabarles J, Superable JT. Post-ASAP Coverage Survey. Memorandum to Dr. G. Bayugo, Nutrition Service, FETP/DOH, February 21, 1994.

Department of Health. Balik Sarap: Sangkap Pinoy '94: The Philippines Experience in Massive Micronutrient Intervention Year 2. Nutrition Service, 1995.

Gillespie S, Mason J. Controlling Vitamin A Deficiency: ACC/SCN State-of-the-Art Series Nutrition Policy Discussion Paper No. 14. Geneva, Switzerland: Administrative Committee on Coordination-Sub Committee on Nutrition (ACC/SCN) 1994.

Humphrey JH, West KP Jr., Sommer A. Vitamin A deficiency and attributable mortality among under-5-year-olds. Bull WHO 1992; 70:225-232.

Katz J, West KP Jr., Khatry SK, Thapa MD, LeClerq SC, Prdhan EK, Pokhrel RP, Sommer A. Impact of vitamin A supplementation on prevalence and incidence of xerophthalmia in Nepal. Invest Opthalmol Vis Sci, 1995. (get article from KWest)

Klemm R, Villate E. Xerophthalmia prevalence survey in rural and urban depressed communities. Paper presented at the National Vitamin A Symposium, Department of Health, Manila, August 1990.

Klemm R, Villate E, Mendoza O. Integration of vitamin A supplementation and nutrition education into DOH community health services: a case study of impact and processes. Paper presented at the XV IVACG meeting in Ecuador, 1991.

National Center for health Statistics. Growth curves for children birth-18 years. Vital Health Stat 1977; 11: 1-165.

Rosen DS, Sloan NL, del Rosario A, de la Paz TC. Risk factors for vitamin A deficiency in rural areas of the Philippines. J Trop Pediatr 1994; 40:82-87

Serdoncillo MS. Executive Summary of the Third Post-ASAP Coverage Survey. Nutrition Service, Department of Health (undated).

Solon FS, Popkin VM, Fernandex TL, Latham MC. Vitamin A deficiency in the Philippines: a study of xerophthalmia in Cebu. Am J Clin Nutr 1978;31:360-368.

Solon FS, Fernandez TL, Latham MC, Popkin BM. An evaluation of strategies to control vitamin A deficiency in the Philippines. Am J Clin Nutr 1979;32:1445-1453.

Sommer A, Tarwotjo I, Hussaini G, Susanto D, Soegiharto T. Incidence, prevalence and scale of blinding malnutrition. Lancet 1981: 1407-1408.

Sommer A, Hussaini G, Muhilal H, Tarwotjo I, Susanto D, Saroso JS. History of night blindness: a simple tool for xerophthalmia screening . Am J Clin Nutr 1980; 33:887-91

Sommer A, Tarwotjo I, Hussaini G, Susanto D. Increased mortality in children with mild vitamin A deficiency. Lancet 1983;2:585-8.

Sommer A. Vitamin A Deficiency and its Consequences: Field guide to Their Detection and Control. Third edition. Geneva, Switzerland: World Health Organization 1995.

Sommer A, Tarwotjo I, Djunaedi E, West KP Jr., Loeden AA, Tilden RL, Mele L, Aceh Study Group. Impact of vitamin A supplementation on childhood mortality: a randomized controlled community trial. Lancet 1986; 1:1169-73.

Stoll BJ, Banu H, Kabir I, Molla A. Night blindness and vitamin A deficiency in children attending a diarrheal disease hospital in Bangladesh. J Trop Pediatr 1985;31:36-9

Tonascia JA. Meta-analysis of published community trials: Impact of vitamin A on mortality. In Bellagio Meeting on Vitamin A Deficiency and Childhood Mortality, KP West, Jr. (ed.) Helen Keller International. New York, 1993.

Tanchoco CC, Cilindro PA, Pingol MC, Magbitang JA, Flores EG, Mendoza SS, Velandria FV. Third national nutrition survey: Clinical and Anthropometric phase. Philippines.

West KP Jr., Sommer A. Periodic, Large Oral Doses of Vitamin A for the Prevention of Vitamin A Deficiency and Xerophthalmia: a Summary of Experiences. Washington DC: The Nutrition Foundation Inc. 1984.